# Scheme of work

## Combined Science: Trilogy - Foundation

## Biology - Organisation

This resource provides guidance for teaching the Organisation topic from our new GCSE in Biology 8464. It has been updated from the draft version to reflect the changes made in the accredited specification.

A new Required practical activity on food tests has been added to section 4.2.2.1 and there is more specific wording to the Required practical activity enzymes which is also in this section. There have also been minor changes to the specification content in sections, 4.2.2.1 The human digestive system, 4.2.2.3 Blood, 4.2.2.4 Coronary disease, 4.2.2.5 Health issues, 4.2.3.1 Plant tissues and 4.2.3.2 Plant organ system. These alterations have not required changes to be made to the Scheme of work.

The scheme of work is designed to be a flexible medium term plan for teaching content and development of the skills that will be assessed.

It is provided in Word format to help you create your own teaching plan – you can edit and customise it according to your needs. This scheme of work is not exhaustive; it only suggests activities and resources you could find useful in your teaching.

### 4.2 Organisation

### 4.2.1 Principles of organisation

| **Spec ref.** | **Summary of the specification content** | **Learning outcomes**  *What most candidates should be able to do* | **Suggested timing (hours)** | **Opportunities to develop scientific communication skills** | **Opportunities to develop and apply practical and enquiry skills** | **Self/peer assessment**  **Opportunities and resources**  *Reference to past questions that indicate success* |
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| 4.2.1 | Principles of organisation | Cells are the basic building blocks of all living organisms.  A tissue is a group of cells with a similar structure and function.  Organs are aggregations of tissues performing specific functions.  Organs are organised into organ systems, which work together to form organisms. | 1 | Students should be able to develop an understanding of size and scale in relation to cells, tissues, organs and systems. | Examine an anatomical model of the digestive system.  Compare the positions of where students think organs are with those in the model. | [Exampro user guide Powerpoint](http://filestore.aqa.org.uk/resources/science/AQA-GCSE-SCIENCE-EXAMPRO-UG.PPTX) |

### 4.2.2 Animal tissues, organs and organ systems

| **Spec ref.** | **Summary of the specification content** | **Learning outcomes**  *What most candidates should be able to do* | **Suggested timing (hours)** | **Opportunities to develop scientific communication skills** | **Opportunities to develop and apply practical and enquiry skills** | **Self/peer assessment**  **Opportunities and resources**  *Reference to past questions that indicate success* |
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| 4.2.2.1 | The human digestive system  **Required practical activity:** use qualitative reagents to test for a range of carbohydrates, lipids and proteins.  To include: Benedict’s test for sugars; iodine test for starch; and Biuret reagent for protein.  AT skills covered by this practical activity: AT 2 and 8. | The digestive system is an example of an organ system in which several organs work together to digest and absorb food. | 1 | Recap the work done in KS3 by asking students to label a diagram of the human digestive system including the main organs and whether they complete mechanical or chemical digestion.  Describe the lining structure of the stomach and what role acid plays in protecting the body from infection. | Students investigate the digestion of a starchy foodstuff by amylase in visking tubing as a model gut. Test for sugar within and outside the model gut using Clinistix or Benedict’s reagent and iodine. |  |
| 4.2.2.1 | Enzymes | The ‘lock and key theory’ is a simplified model of enzyme action.  Enzymes:   * are biological catalysts that speed up chemical reactions in living organisms * are large proteins * catalyse a specific reaction due to the shape of the active site * are denatured by high temperature and extremes of pH due to changes in the shape of the active site * have an optimum temperature * have an optimum pH. | 1 | Define an enzyme.  Describe the lock and key model, including substrates and products for the three main groups of digestive enzymes.  Discuss the induced fit theory of enzyme action and compare it to the lock and key model. Ask students to come up with their own ideas to describe enzyme action.  Students write a method for fairly investigating the effect of temperature on the rate of decomposition. | Use plasticine to make models of the lock and key enzymes for proteases, carbohydrases and lipases, showing what the substrates are broken into.  Demonstrate the effect of raw liver on hydrogen peroxide (due to the enzyme catalase which breaks hydrogen peroxide into water and oxygen).  Students can investigate the effect of raw and boiled potato on hydrogen peroxide. Alter the temperature of the potato so one raw part is cold and one is room temperature. |  |
| 4.2.2.1 | Digestive enzymes  **Required practical activity**: investigate the effect of pH on the rate of reaction of amylase enzyme.  Students should use a continuous sampling technique to determine the time taken to completely digest a starch solution at a range of pH values. Iodine reagent is to be used to test for starch every 30seconds. Temperature must be controlled by use of a water bath or electric heater.  AT skills covered by this practical activity: AT 1, 2,5 and 8. | Students should be able to recall the sites of production and the action of amylase, proteases and lipases.  Digestive enzymes convert food into small soluble molecules that can be absorbed into the bloodstream.  Carbohydrases break down carbohydrates to simple sugars.  Amylase is a carbohydrase which breaks down starch.  Proteases break down proteins to amino acids.  Lipases break down lipids (fats) to glycerol and fatty acids.  The products of digestion are used to build new carbohydrates, lipids and proteins. Some glucose is used in respiration. | 3 | Add the sites of production and the action of amylase, proteases and lipases to a diagram of the human digestive system.  Students will write up their experiments and describe how the factors influence the rate of digestion.  Students should be able to understand simple word equations but no chemical symbol equations are required. | Students can leave a piece of white bread in the mouth for an extended period of time to allow the starch to be digested into sugar by saliva.  Students can investigate how the enzymes in some fruits digest protein (and stop gelatine from solidifying). Add equal sizes of fresh, canned and frozen pineapple into test tubes of warm gelatine (plus one as a control) and leave to set in an ice cold water bath.  Compare solidity of results. Discuss what you would have to do to ensure that gelatine solidifies. Discuss which might make the best meat tenderizer and why.  Investigate the time taken for different concentrations of trypsin to digest the gelatine coating on photographic film.  Investigate how changing temperature affects the time taken for lipase to break down the fat in milk into fatty acids and glycerol. |  |
| 4.2.2.1 | Bile | Bile is made in the liver and stored in the gall bladder. It is alkaline to neutralise hydrochloric acid from the stomach. It also emulsifies fat to form small droplets which increases the surface area. The alkaline conditions and large surface area increase the rate of fat breakdown by lipase. | 1 | Students can add bile to their diagram of the human digestive system to describe where it is made and where it is stored.  Discuss what pH with contents of the stomach will be and what this could do to the intestine.  Write the method for investigating the effect of bile on the digestion of fats.  Determine that the indicator changes because the solution becomes more acidic (lower pH).  Students should describe how the increased surface area of emulsified fat increases the rate of enzyme action. | Recap the pH scale by adding acid and alkali to UI indicator. Compare with the effects of acid and alkali on phenolphthalein.  Demonstrate the action of vegetable oil and water shaken together to illustrate the smaller droplet size and hence increased surface area. Highlight to students that the increased surface area of the droplets is needed to increase breakdown rate.  Demonstrate the action of an emulsifier by mixing oil and water and then adding lecithin (or mustard).  Students investigate how bile affects the rate of digestion by lipase on full fat milk, sodium carbonate and phenolphthalein solutions. |  |
| 4.2.2.2 | The heart and lungs | Students should know the structure and functioning of the human heart and lungs, including how lungs are adapted for gaseous exchange.  Knowledge of the lungs is restricted to the trachea, bronchi, alveoli and the capillary network surrounding the alveoli.  The heart is an organ that pumps blood around the body in a double circulatory system. The right ventricle pumps blood to the lungs where gas exchange takes place. The left ventricle pumps blood around the rest of the body.  Knowledge of the blood vessels associated with the heart is limited to the aorta, vena cava, pulmonary artery, pulmonary vein and coronary arteries.  Knowledge of the names of the heart valves is not required.  The natural resting heart rate is controlled by a group of cells located in the right atrium that act as a pacemaker. Artificial pacemakers are electrical devices used to correct irregularities in the heart rate. | 3 | Ask students to recap KS3 by labelling a diagram of the breathing system and describing the organs and tissues within it.  Revisit diffusion and the role that this plays in getting oxygen into our blood.  The capacity of lungs is proportional to the surface area of a person’s body. Students can calculate their body surface area (there are many body surface area calculators available, eg [Cornell University – Calculate Body Surface Area](http://www-users.med.cornell.edu/~spon/picu/calc/bsacalc.htm) )  and can calculate the estimated vital capacity by using the formula:  Males: SA x 2500  Females: SA x 2000.  Ask students to recap KS3 by labelling a diagram of the circulatory system and describing the organs and tissues within it.  Colour code the diagram to show where there is oxygenated and deoxygenated blood.  Label a diagram of the heart to show the main chambers and directions of blood flow.  Describe the use of artificial pacemakers to regulate heart beats. | Students can measure their lung capacity (there are various methods available online using balloons if vital capacity bags are not available).  Demonstrate a pig’s pluck if available to identify the differences in composition between heart muscle and lungs.  Students can dissect a heart to examine the internal structures.  Students can role play the circulatory system by walking around students acting as the lung and body systems (through the heart). Use blue and red paper to represent oxygen and carbon dioxide, with different numbers to represent concentration gradients in the lungs and blood.  Students can measure their resting heart and breathing rates.  Students can examine diagrams of regular and irregular heartbeats. View the animation of how a pacemaker works to restore normal rhythm: [Watch, Learn and Live Interactive Cardiovascular library](http://watchlearnlive.heart.org/CVML_Player.php?moduleSelect=pacmkr) |  |
| 4.2.2.2 | Blood vessels | The body contains three different types of blood  vessel:  • arteries  • veins  • capillaries.  Students should be able to explain how the structure of these vessels relates to their functions. | 1 | Draw and label diagrams of the blood vessels.  Describe their functions and how the pressure varies within them.  Discuss how varicose veins occur and how they can be prevented. | Demonstrate the difference in blood flow between veins and arteries by flowing red dyed water out of the base of cups. Use a large round straw for arteries, a flattened large straw for veins and small bore straw for capillaries. Plug gaps with plasticine. Investigate the different rate of cup emptying through different bore straws. |  |
| 4.2.2.3 | Blood | Blood is a tissue consisting of plasma, in which the red blood cells, white blood cells and platelets are suspended.   * Plasma transports proteins and other chemical substances around the body. * Red blood cells contain haemoglobin which binds to oxygen to transport it from the lungs to the tissues. * White blood cells help to protect the body against infection. * Platelets are fragments of cells which initiate the clotting process at wound sites.   Students should be able to recognise different types of blood cells in a photograph or diagram, and explain how they are adapted to their functions. | 1 | View electron scanning photos of different blood cells.  Draw and label diagrams of main components of blood and describe their functions.  Calculate the weights of different materials needed to make 250 g of blood.  Students can discuss the model and how well it represents real blood. Discuss the use of real blood in the lab and why it is considered hazardous, including issues with clotting.    Draw a test tube and section it to show the differing proportions of cells and plasma in a blood (or label a preconfigured test tube diagram). | Examine blood slides under the microscope. Determine there are more red blood cells than white or platelets.  Use red dyed hoop breakfast cereal, yellow dyed water (plasma), nutrient shake powder to represent dissolved substances, mini marshmallows (white blood cells) and rice as platelets to make model blood in a beaker.  Proportions are: 55% plasma, 45% cells.  The plasma is 93% water (158 g) and 7% dissolved substances. The cells are 99% red blood cells and 1% platelets/ white blood cells. |  |
| 4.2.2.4 | Coronary heart disease: a non-communicable disease | In coronary heart disease layers of fatty material build up inside the coronary arteries, narrowing them. This reduces the flow of blood through the coronary arteries, resulting in a lack of oxygen for the heart muscle.  Stents are used to keep the coronary arteries open.  Statins are widely used to reduce blood cholesterol levels which slow down the rate of fatty material deposit.  In some people heart valves may become faulty, preventing the valve from opening fully, or the heart valve might develop a leak.  Students should understand the consequences of faulty valves. Faulty heart valves can be replaced using biological or mechanical valves.  In the case of heart failure a donor heart, or heart and lungs can be transplanted. Artificial hearts are occasionally used to keep patients alive whilst waiting for a heart transplant, or to allow the heart to rest as an aid to recovery. | 1 | Show examples of cholesterol reducing products. Discuss how high fat diets might lead to blockages in arteries and how we treat these.  Students use provided research material to describe the advantages and disadvantages of treating cardiovascular diseases by drugs, mechanical devices or transplant, ie:  [NHS – Treating heart disease](http://www.nhs.uk/Conditions/Coronary-heart-disease/Pages/Treatment.aspx)    [British Heart Foundation – Treatments](https://www.bhf.org.uk/heart-health/treatments) | Students can investigate what happens when arteries clog up.  Revisit the model made in the previous lesson. Demonstrate what may happen to the viscosity of the blood when there is a surplus of fats, ie adding melted lard to the mixture (this will cool and form thickening droplets in the mixture).  Using the straw out of the base of a cup, examine the difference in blood flow in artery straws partially sealed by plasticine ‘cholesterol’.  Decide at what point medical treatment may need to be a mechanical ‘stent’ holding the artery open. |  |
| 4.2.2.5 | Health issues | Health is the state of physical and mental wellbeing.  Diseases, both communicable and non-communicable, are major causes of ill health. Other factors including diet, stress and life situations may have a profound effect on both physical and mental health.  Different types of disease may interact.  Defects in the immune system mean that an individual is more likely to suffer from infectious diseases.  Viruses living in cells can be the trigger for cancers.  Immune reactions initially caused by a pathogen can trigger allergies such as skin rashes and asthma.  Severe physical ill health can lead to depression and other mental illnesses. | 1 | Students can examine a range of data on local and national health statistics of the Human papilloma virus (HPV) vaccine and how cervical cancer is linked to the virus.  Students can look at media stories about how diseases are linked:  [Mail Online – Immune system and the common cold](http://www.dailymail.co.uk/health/article-2810205/The-real-reason-feel-ghastly-catch-cold-s-immune-s-fault.html)  [The Guardian – Is depression a result of inflammation caused by the immune system?](http://www.theguardian.com/lifeandstyle/2015/jan/04/depression-allergic-reaction-inflammation-immune-system)  [The Independent – Master Immunologist with a controversial answer to why allergies exist](http://www.independent.co.uk/news/science/ruslan-medzhitov-interview-the-master-immunologist-with-a-controversial-answer-to-why-allergies-exist-10170913.html)  Look at the evidence to support how diseases interact.  Produce a summary poster describing the evidence cited in the news stories, considering how it is linked to scientific research. | Use data and statistics as supporting evidence. |  |
| 4.2.2.6 | The effect of lifestyle on some non-communicable diseases | Students should recall that many non-communicable  diseases are caused by the  interaction of a number of factors (to include cardiovascular disease, some lung and liver diseases and diseases influenced by nutrition, including Type 2 diabetes).  Risk factors are linked to an increased rate of a disease.  They can be:   * aspects of a person’s lifestyle * substances in a person’s body or environment.   A causal mechanism has been proven for some risk factors, but not in others:   * The effects of diet, smoking and exercise on cardiovascular disease. * Obesity as a risk factor for Type 2 diabetes. * The effect of alcohol on the liver and brain function. * The effect of smoking on lung disease and lung cancer. * The effects of smoking and alcohol on unborn babies. * Carcinogens, including ionising radiation, as risk factors in cancer. | 2 | Choose one area to research and produce an information leaflet to put in school staff rooms, describing to non-science teachers how the consequences of lifestyle and substance abuse impact an individual, the local community and health system and the whole nation. Students need to link the risks with the interactions of the different factors on overall health.  Include both the human and financial cost of non-communicable diseases.  Opportunity to use and translate data: the booklet should include the students’ interpretations of numerical data into a more easily readable format for a lay person. | Use online data to support observations. |  |
| 4.2.2.7 | Cancer | Benign tumours and malignant tumours result from uncontrolled cell division.  Malignant tumour cells are cancers. They invade neighbouring tissues and spread to different parts of the body in the blood where they form secondary tumours.  Scientists have identified lifestyle risk factors for various types of cancer, including smoking, obesity, common viruses and UV exposure.  There are also genetic risk factors for some cancers. | 1 | Define what cancer is.  Describe the major kinds of cancer in the UK.  Recall from PSHE how cancer risks can be minimised. Describe what risks may be harder to reduce due to inherited characteristics.  Recall the HPV vaccination and reasons for its introduction.  Research news and media articles about cancer. Make a summary poster on the story. | There are various reputable animations available online of what cancer is and how it develops: [Cancer Treatment Centers of America – Cancer Medical animation](http://www.cancercenter.com/video/what-is-cancer/cancer-overview/) |  |

### 4.2.3 Plant tissues, organs and systems

| **Spec ref.** | **Summary of the specification content** | **Learning outcomes**  *What most candidates should be able to do* | **Suggested timing (hours)** | **Opportunities to develop scientific communication skills** | **Opportunities to develop and apply practical and enquiry skills** | **Self/peer assessment**  **Opportunities and resources**  *Reference to past questions that indicate success* |
| --- | --- | --- | --- | --- | --- | --- |
| 4.2.3.1 | Plant tissues and organs | Plant tissues include:   * epidermal tissues, which cover the plant * palisade mesophyll, which carries out photosynthesis * spongy mesophyll, which has air spaces for diffusion of gases * xylem and phloem, which transport substances around the plant * meristem tissue found at the growing tips of shoots and roots which will differentiate into different plant cells.   The leaf is a plant organ. The structures of tissues in the leaf are related to their functions.  Knowledge limited to epidermis, palisade and spongy mesophyll, xylem and phloem and guard cells. | 1 | Recall plant structures from KS3 by asking students to draw and label the main tissues and organs of a plant.  Draw the main cells in a leaf section.  Label a diagram of the transverse section of a leaf.  Describe the functions of the epidermis, palisade and spongy mesophyll. | Students observe the similarities and differences of a variety of leaves.  Observe premade slides of transverse leaf sections through a microscope.  Students make A5 drawings of the different cells in a leaf section and stick onto white board to form a cross- section diagram through a leaf. Use labels from white board to help label leaf diagram in books. |  |
| 4.2.3.2 | Plant organ system  The stem | Students should be able to explain the effect of changing temperature, humidity, air flow and light intensity on the rate of transpiration.  Xylem tissue transports water and mineral ions from the roots to the stems and leaves. It is composed of hollow tubes strengthened by lignin adapted for the transport of water in the transpiration stream.  Phloem tissue transports dissolved sugars from the leaves to the rest of the plant for immediate use or storage. The movement of food through phloem tissue is called translocation.  Phloem is composed of tubes of elongated cells. Cell sap can move from one phloem cell to the next through pores in the end walls. Detailed structure of phloem tissue or the mechanism of transport is not required. | 2 | Students describe how the roots and leaf are linked by the stem.  Draw and label the direction and substances transported by xylem and phloem.  Define transpiration.    Describe how factors affect the rate of transpiration:   * temperature * humidity * air flow * light intensity. | Students can examine thin cross sections of celery that has been left in coloured water to identify the xylem vessels.  Students can make coloured flowers using carnations soaked in coloured water (if stems are split into sections, multi-coloured flowers will occur).  Measure the rate of transpiration by the uptake of water using a potometer. Investigate how the rate changes if a hair dryer is used on the leaf. |  |
| 4.2.3.2 | Root hairs | Root hair cells are adapted for the efficient uptake of water by osmosis and mineral ions by active transport. | 1 | Describe the structure and function of root hair cells. | Revisit the broad bean seed root hair cells. |  |
| 4.2.3.2 | Stomata | The role of stomata and guard cells is to control gas exchange and water loss. | 1 | Give students a diagram of the stomata on the underside of a leaf and ask them to recap from KS3 the structure and function of stomata. | Investigate the distribution of stomata and guard cells on the top and bottom surfaces of leaves. |  |